

Appl. No. 09/891/272
Amdt. Dated 11/21/03
Reply to Office action of July 24, 2003

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A method of separating a target material from a liquid mixture suspension or dispersion, said method comprising the steps of: combining a mass of magnetizable particles to with said suspension or dispersion liquid mixture containing said target material for sufficient time for said target material to bind to said magnetizable particles, each of said magnetizable particles comprising an aggregate formed of a particle of crystallites of a magnetizable metal oxide, a coating on said aggregates and having a coating of a polysaccharide derivative having at least one pendant functional group, and a coupling group having an affinity for said target material, which coupling group is attached by means of said functional group to said polysaccharide coating; and applying a magnetic field to said liquid mixture suspension or dispersion and separating said mass of said magnetizable particles and target material.

Claim 2 (original): The method of claim 1, wherein said target material is an inorganic material, organic compound or biological material.

Claim 3 (currently amended): The method of claim 1, wherein said magnetizable particles comprise an aggregate a mass of crystallites, said crystallites having a particle size of about 3 nm to about 25 nm.

Claim 4 (currently amended): The method of claim 1, wherein said magnetizable magnetic particles have a particle size of about 50 nm to about 500 nm, said magnetizable magnetic particles being readily dispersible in a liquid medium.

Claim 5 (currently amended): The method of claim 1, wherein said magnetizable

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magnetic particles have a particle size of about 70 nm to about 450 nm, said magnetizable magnetic particles being readily dispersible in a liquid medium.

Claim 6 (currently amended): The method of claim 1, wherein said polysaccharide derivative is bonded directly to said aggregate particles of crystallites of said magnetizable metal oxide.

Claim 7 (currently amended): The method of claim 1, wherein said aggregate particles of said crystallites of said magnetizable metal oxide includes a coating of an organosilane bonded directly to said aggregate particles of said crystallites, and wherein said coating of said polysaccharide derivative is bonded to said organosilane.

Claim 8 (original): The method of claim 1, wherein a purified complex of said magnetizable particles bound to said target material is dissociated and said magnetizable particles are removed by magnetic means to provide a substantially pure preparation of said target material.

Claim 9 (original): The method of claim 1, wherein said magnetizable metal oxide is a magnetizable iron oxide.

Claim 10 (currently amended): The method of claim 1, wherein said aggregate of crystallites magnetizable particles is are prepared from precipitated magnetite which has been aged to increase the size of said aggregate[[s]].

Claim 11 (currently amended): The method of claim 1, wherein said aggregate of crystallites magnetizable particles is are produced by treating precipitated magnetite magnetizable aggregates with an acid, with a solution of a ferric salt, or with a base to form a colloidal suspension.

Claim 12 (currently amended): The method of claim 1, wherein said aggregate of crystallites magnetizable particles is are produced by treating precipitated magnetite magnetizable aggregates with a reactant selected from the group consisting of nitric acid, perchloric acid, a solution of ferric nitrate and tetramethylammonium hydroxide.

Claim 13 (original): The method of claim 7, wherein said organosilane has a pendant functional group to which a polysaccharide or functionalized polysaccharide may be attached.

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Claim 14 (currently amended): The method of claim 1, wherein said pendant functional group of the polysaccharide is a carboxyl group, a carbonate, an amino group or derivatized amino group, an aldehyde group, a sulfhydryl group, or a displaceable group, ~~such as a halide or a sulfonate.~~

Claim 15 (original): The method of claim 1, wherein said pendant functional group of the polysaccharide is a carboxyl group attached to the polysaccharide through a linker having at least one heteroatom for every three carbon atoms in the linker.

Claim 16 (original): The method of claim 15, wherein said heteroatom of the linker is O.

Claim 17 (original): The method of claim 15, wherein said linker is derived from ethylene glycol, an oligoethylene glycol or a polyethylene glycol.

Claim 18 (original): The method of claim 15, wherein said pendant functional group of the polysaccharide is introduced by reaction with chloroethoxyethoxyacetic acid and base.

Claim 19 (original): The method of claim 1, wherein said polysaccharide is dextran.

Claim 20 (withdrawn): A method of producing magnetizable particles for separation of a target material, said method comprising the steps of: providing aggregates of crystallites of a magnetizable metal oxide; coating said aggregates with a polysaccharide derivative having pendant functional groups; and coupling a coupling group to said functional group to form said magnetizable particles, said coupling group having a binding affinity for said target material and said magnetizable particles being dispersible in a liquid and being separable from a liquid applying a magnetic field.

Claim 21 (withdrawn): The method of claim 20, further comprising the steps of dispersing said aggregates in a liquid and mixing said polysaccharide derivative with said liquid for a time sufficient to react said polysaccharide derivative with said aggregates to coat said aggregates.

Claim 22 (withdrawn): The method of claim 20, wherein said aggregates comprise crystallites of said magnetizable metal oxide having a particle size of about 3 nm to about 25 nm.

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Claim 23 (withdrawn): The method of claim 20, wherein said magnetizable particles have a particle size of about 100 nm to about 450 nm.

Claim 24 (withdrawn): The method of claim 20, further comprising the steps of dispersing said aggregate in a liquid reaction medium and adding an organosilane to said liquid reaction medium for a time sufficient to coat said aggregates, and form silane coated aggregates, and thereafter coating said silane coated aggregates with said polysaccharide derivative.

Claim 25 (withdrawn): The method of claim 20, wherein said magnetizable metal oxide is a magnetizable iron oxide.

Claim 26 (withdrawn): The method of claim 20, wherein said aggregates are prepared by precipitating magnetite from a slurry which has been aged for a time sufficient to increase the size of said aggregates.

Claim 27 (withdrawn): The method of claim 20, wherein prior to coating with said polysaccharide, said aggregates are treated with an acid, with a solution of a ferric salt, or with a base to form a colloidal suspension.

Claim 28 (withdrawn): The method of claim 20, wherein said aggregates are treated with a reactant to form a colloidal solution, wherein said reactant is selected from the group consisting of nitric acid, perchloric acid, a solution of ferric nitrate and tetramethylammonium hydroxide.

Claim 29 (withdrawn): The method of claim 20, wherein said organosilane has a pendant functional group to which a polysaccharide or functionalized polysaccharide may be attached.

Claim 30 (withdrawn): The method of claim 20, wherein said pendant functional group of said polysaccharide is a carboxyl group, a carbonate, an amino group or derivatized amino group, an aldehyde group, a sulfhydryl group, a halide or a sulfonate.

Claim 31 (withdrawn): The method of claim 20, wherein said pendant functional group of said polysaccharide is a carboxyl group attached to the polysaccharide through a linker having at least one heteroatom for every three carbon atoms in the linker.

Claim 32 (withdrawn): The method of claim 31, wherein said heteroatom of the

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linker is O.

Claim 33 (withdrawn): The method of claim 31, wherein said linker is derived from ethylene glycol, an oligoethylene glycol or a polyethylene glycol.

Claim 34 (withdrawn): The method of claim 31, wherein said pendant functional group of the polysaccharide is introduced by reaction with chloroethoxyethoxyacetic acid and base.

Claim 35 (withdrawn): The method of claim 20, wherein said polysaccharide is dextran.

Claim 36 (withdrawn): A method for preparing discrete aggregates of a magnetic transition metal oxide, said method comprising the steps of: dispersing transition metal ions in a liquid medium in the presence of a base in an amount to produce crystallites of said magnetic transition metal oxide having a particle size of about 3 nm to about 25 nm, thereafter aging said mixture for a time sufficient for the crystallites to form aggregates of said magnetic transition metal oxide having a particle size of about 50 nm to about 500 nm, then converting said aggregates to a colloid by treatment with a reagent chosen from the group consisting of an acid, a base and a source of ferric ions, and subsequently removing the majority of the reagent.

Claim 37 (withdrawn): The method of claim 36, wherein said magnetizable metal oxide is a magnetizable iron oxide.

Claim 38 (withdrawn): The method of claim 36, wherein said crystallites of magnetizable iron oxide are prepared by the interaction of a solution of ferrous and ferric ions with a solution of ammonium hydroxide.

Claim 39 (withdrawn): The method of claim 36, wherein treating said aggregates with acid, base, or ferric ion, removing a substantial portion of said acid, base or ferric ion, and dispersing said aggregates in dilute acid or dilute base forms a colloidal suspension.

Claim 40 (withdrawn): The method of claim 36, comprising reacting said aggregates with an organosilane, removing excess organosilane, and dispersing said aggregates to form a colloid.

Claim 41 (withdrawn): The method of claim 36, wherein prior to treatment with said organosilane, said method comprises converting said aggregates to a

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colloid by treating said aggregates with acid, base, or ferric ion, removing the majority of said acid, base or ferric ion, and dispersing the aggregates in dilute acid or dilute base to form said colloid.

Claim 42 (withdrawn): The method of claim 40, wherein said organosilane is an aminoalkyl- or aminoaryltrialkoxysilane.

Claim 43 (withdrawn): The method of claim 40, wherein said organosilane is aminopropyltriethoxysilane.

Claim 44 (withdrawn): A method of preparing an aminoarylpolysaccharide or an aminoalkylpolysaccharide, said method comprising the steps of: forming a mixture of a polysaccharide and an alkyl azide or an aryl azide having a reactive functional group spaced from an azide group of said alkyl azide or aryl azide to form an azidopolysaccharide reaction product, and adding a reducing agent to said azidopolysaccharide reaction product to reduce said azide group and form said aminoalkylpolysaccharide or aminoarylpolysaccharide.

Claim 45 (withdrawn): The method of claim 44, comprising reducing azido group to an amino group with a stannous salt in the presence of an agent which prevents the precipitation of the resulting stannic ions.

Claim 46 (withdrawn): The method of claim 45, wherein said stannous ion is used in the presence of a citrate buffer.

Claim 47 (withdrawn): A polysaccharide with pendant carboxyl groups in which the carboxyl group is attached to said polysaccharide through a linker at least four atoms in length and having at least one heteroatom for every three carbon atoms in the linker.

Claim 48 (withdrawn): The method of claim 47, wherein said heteroatom of the linker is O.

Claim 49 (withdrawn): The method of claim 47, wherein said linker is derived from ethylene glycol, an oligoethylene glycol or a polyethylene glycol.

Claim 50 (withdrawn): The method of claim 47, wherein said pendant functional group of the polysaccharide is introduced by reaction with chloroethoxyethoxyacetic acid and base.

Claim 51 (withdrawn): The method of claim 47, wherein said polysaccharide is

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dextran.

Claim 52 (withdrawn): A kit for carrying out the separations of claim 1.

Claim 53 (new): The method of claim 1, wherein the coupling group is selected from the group comprising antibody, nucleic acid, enzyme, ligand, epitope, binding protein, and chelate.